

EXHIBIT 12

**THE ROLE AND PROCESS OF EXPOSURE ASSESSMENT
REGARDING ASBESTOS-RELATED PERSONAL INJURY LIABILITY**

Draft Report Prepared for

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by

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EXPOSURE ASSESSMENT REPORT

OCTOBER 3, 2006

these evaluations.

I have more than 30 years of personal experience working with asbestos and asbestos-related issues. These experiences range from evaluation of worker asbestos exposures at numerous industrial sites in the 1970's, to the evaluation of fiber releases from asbestos-containing materials in schools, offices, and other buildings, development of asbestos management plans, and development of worker training courses in the 1980's, to historic exposure reconstructions in the 1990's, to field evaluation of asbestos fiber exposure related to vermiculite attic insulation in the last several years.

Starting in the early 1990's, I have reviewed numerous reports and literature regarding asbestos related materials, including, but not limited to, those cited herein⁽¹⁰⁻¹⁶⁾ on Monokote fireproofing, and have conducted many inspections of sites with Monokote and other manufacturers' fireproofing. I have collected many samples of these materials for microscopic analysis. In 2002, I conducted a field study for W.R. Grace to characterize exposures to asbestos fibers contained in vermiculite attic insulation during the conduct of a variety of routine tasks.⁽¹⁷⁾ I incorporate these findings by reference into this report.

I have testified twice in the last four years; once related to my field studies of vermiculite attic insulation and once as a fact witness in a matter unrelated to W.R. Grace & Co. or to asbestos-related litigation.^(18,19)

I have attached a copy of my most recently updated CV, dated January 1, 2006.

The opinions expressed in this report are based on my education and training, field and laboratory experience, research, review of the scientific and other literature, and the application of established scientific approaches and knowledge to this problem.

General principles of exposure assessment

The development of asbestosis and asbestos-related lung cancer and mesothelioma require the inhalation of airborne asbestos fibers, *i.e.*, asbestos-related disease is a function of fiber exposure. Although modified differently by other factors, within the limits of currently available data, the risk of all asbestos-related diseases is dependent upon the total number of fibers inhaled (and retained) in the lung. The mere presence in an area with an asbestos-containing product does not in and of itself equate with exposure. In its simplest form, the number of inhaled fibers is the product of the magnitude of the exposure (as measured by the concentration of asbestos fibers in the air inhaled) and the total time the person inhaled those fibers (as measured by the sum of the frequency and duration of individual exposure periods). As discussed below, asbestos type and fiber size also enter into the overall assessment of asbestos fiber exposure.

Before discussing the details of exposure assessment, it is useful to describe how exposure information is used in the basic understanding of disease causation by asbestos or by any other substance. Hill⁽²⁰⁾ describes nine simple and logical criteria that need to be fulfilled in order to demonstrate that a given substance causes disease. At least two of these criteria relate directly to exposure. As described by Hill, in order for a substance to cause a disease in an individual, it

EXPOSURE ASSESSMENT REPORT

OCTOBER 3, 2006

is necessary that the exposure precede the onset of disease. He called this criterion a *temporal relationship*; its relevance to the exposure assessment process is critical. In the case of lung cancer, the mean time between exposure and the onset of disease, called the latency period, is typically about 15-20 years. For mesothelioma, this latency period is longer, typically about 20-40 years.⁽²¹⁻²³⁾ In epidemiologic analyses, based on these latency periods and what is known about the biology of the transformation of healthy cells to malignant cells, it is usual to discount the asbestos exposure that occurred in the 5-10 years immediately preceding the onset of disease since there is very little chance that it contributed to the disease.

A second criterion described by Hill to establish causation is *dose-response*. This is a basic principal of toxicology and is very simple in concept: within the limits of currently available data, the greater the exposure, the greater the severity of non-malignant disease and the greater the risk of malignant disease. The accurate measurement of exposure, in this case asbestos fibers inhaled, is a key component to this determination.

There are four major components of asbestos exposure assessment that predict the probability of disease:

- *magnitude* - the concentration of asbestos fibers in the air inhaled, usually specified in terms of the number of fibers per cubic centimeter (f/cm³) of air.
- *duration* - the length of time during which fibers were inhaled. Since occupational exposures are frequently not continuous, duration is usually calculated as the sum of the frequency and time of individual exposure periods.
- *fiber size* - not all fiber sizes are equal with respect to their ability to cause a malignancy. It is now generally recognized that, all other things being equal, long thin fibers are more potent carcinogens than short fat fibers.
- *fiber type* - not all fiber types are equal with respect to their ability to cause a malignancy.

The magnitude of exposure and the duration of exposure are combined multiplicatively as a measure of the total number of fibers entering the body. This metric is often called the cumulative exposure (or sometimes, dose) and is the typical exposure input to epidemiologic/risk assessment predictions of future disease occurrence. Thus, by way of example, someone working at Job Title X and exposed to an average annual magnitude of 2 fibers/cm³ of air multiplied by the 15 years worked at that concentration, would be said to have a cumulative exposure of 30 fiber/cm³-years, usually simplified as 30 fiber-years, associated with that job. If this person then worked at Job Title Y and was exposed to an average magnitude of 3 fibers/cm³ of air multiplied by the additional 5 years worked at that concentration, he would be said to have a cumulative exposure of 15 fiber-years associated with that job. His total cumulative exposure would thus be 30 fiber-years associated with Job Title X plus 15 fiber-years associated with Job Title Y to equal a total of 45 fiber-years.

The validity and reliability of the exposure estimation is critically dependant on good exposure information related to the above factors. As is discussed below, given an individual worker with a specified job title, task description, or use of a product, reliable exposure information is often

EXPOSURE ASSESSMENT REPORT

OCTOBER 3, 2006

available in the published peer-reviewed literature, in various government, company, and industry reports, and through modeling to allow good estimation of exposure magnitude, fiber size, and fiber type. Illustrative examples of such materials are cited herein.^(10-16, 24-26) Information on the duration of exposure, however, is dependent upon the quality of that worker's report.

Assessment of contemporary and historic exposures

Industrial hygienists have measured exposures of workers to asbestos fibers since at least the World War II era. Concurrently, professional organizations, e.g., the American Conference of Governmental Industrial Hygienists, and starting in 1970, governmental agencies, i.e., the Occupational Safety and Health Administration, have developed exposure guidelines and regulations to limit workers' exposures to these fibers. As the state of knowledge and the needed tools evolved over this same period, the level of recommended/permissible occupational exposures decreased from approximately 30 to the current 0.1 fibers/cm³ of air, expressed as an 8-hour time weighted average concentration.

Through this period, the methods and technology used to measure asbestos exposure have also evolved. An understanding of this evolution is essential to the evaluation of historical measures of exposure for use in this assessment. Prior to the late 1960's, asbestos exposure assessment was accomplished by drawing a large volume of air through a Greenberg-Smith impinger partially filled with water. Such samples were typically very short in duration (on the order of 15 minutes) and were collected in the general vicinity of a worker. The water was examined under a light microscope, the number of particles counted, and the concentration of particles calculated. The resulting estimation of exposure was non-specific, i.e., it included particles in addition to the asbestos fibers, and typically represented the exposure associated with a single short-term task or activity. Beginning in the late 1960's, sample collection technology changed to the deposition of asbestos-containing dust on a piece of filter paper and the subsequent enumeration of deposited fibers using phase contrast light microscopic analysis. The battery-powered pump used to draw air through the filter, as a part of this method was small and lightweight, allowing for collection of air samples in the worker's breathing zone over the entire course of an 8-hour workday. Analysis using phase contrast light microscopy allowed the viewing and counting of individual fibers, although as before, asbestos fibers could not be differentiated from non-asbestos fibers. In general this did not represent a problem in industries that used asbestos fibers in the manufacturing process, but the later application of these methods to low-level exposures in non-occupational settings was associated with the over-estimation of asbestos exposures due to the relatively greater prevalence of non-asbestos fibers. In addition, the limited resolution of light microscopy meant that very fine fibers were not visible and, therefore, were not counted. Increasingly through the 1980's and into the 1990's, samples collected on filters have been analyzed using transmission electron microscopy that permits the visualization of virtually all fibers and is able to differentiate between the different types of asbestos fibers and non-asbestos fibers. It also makes the sizing of fibers possible.

While the methods for measuring exposure have been available in one form or another for some 60 years, there is a near-universal lack of person-specific exposure measurements for individuals in the claimant (or any other) population. Further, because the exposures that are responsible for current disease occurred many years in the past, we are forced to develop and rely on other means to determine historic exposures. These methods are often called

EXPOSURE ASSESSMENT REPORT

OCTOBER 3, 2006

retrospective assessment methods. In order to accurately assess the risk of disease for compounds such as asbestos, one must develop a lifetime asbestos exposure history.

Historic exposure reconstruction

In order to quantify the risk of future disease, the epidemiologist/risk assessor requires, among other things, a quantitative estimate of exposure and exposure timing, *i.e.*, when did it begin and how long did it continue. The most common tool used to quantitatively describe historic exposures is the Job Exposure Matrix or JEM. A JEM represents the summary of exposure evaluations in which an exposure (in terms of airborne fiber concentration) is assigned for a specific product based on job title or conditions of use. If there are temporal differences in exposure not specifically related to job title or conditions of use, date may also be included in a JEM. As described previously, the inputs to the JEM may include information gleaned from published peer-reviewed literature, various government, company, and industry reports, and through modeling. The strength associated with the use of a JEM in the assessment of exposures of a population is that it provides structure and consistency of exposure estimates based on known information. Thus, based on exposure data from this wide variety of sources (discussed in more detail below), all persons in a study with the same job title, working in the same manner with the same product in a given year would be assigned the same exposure.

The usefulness and reliability of a JEM is based on the accuracy of the information provided in it. Since it provides historical estimates of exposure, JEM's rely primarily on historical documents. The relevance and validity of each of these documents must be scrutinized by the exposure assessor before including the information contained into the JEM. Published and unpublished studies form the primary input to most JEM's. Information in peer-reviewed published studies, government reports, company reports, and any other available historical source may be considered for use. The documents are individually evaluated based on the quality of description, the validity of methods used, and consistency with other information. Most such publications and reports provide information by job title only and, thus, are lacking information on potential exposure differences between products of different manufacturers. Company data may alleviate this problem, but such data are, in general, relatively sparse. Studies that report on personal exposure measurements under original use conditions, *i.e.*, during actual contemporaneous work, provide valuable estimates of exposure, although they are sometimes hindered by the use of historic measurement methods. Contemporaneous studies that use fixed site area sampling may also be used, but adjustments must be made to estimate worker personal exposures. Recreations of historic work situations with exposure measurements using modern techniques can provide detailed exposure information where it may have been lacking in the past. The limitation of such studies, and a critical determination to be made by the exposure assessor, is how well the recreation represents the actual conditions it is meant to duplicate. Finally, mathematical models based on a wide variety of known data and assumptions are sometime used to estimate exposures.

The inclusion of manufacturer-specific information is not typical for JEM's used in most epidemiologic/risk assessment studies because most studies seek to determine the risk associated with a job that would typically use products manufactured by a variety of corporations. Thus, a pipe insulator is exposed to the products of many manufacturers and the exposure that is determined is a weighted average of an unspecified mix of products from different manufacturers. In fact, over the course of a working career, a worker might be

EXPOSURE ASSESSMENT REPORT

OCTOBER 3, 2006

above a suspended ceiling to replace light fixtures, pull cables, repair plumbing, repair ventilation systems, etc. During these periods, disturbance of the fireproofing, if any, was typically incidental, *i.e.*, not required as part of the task. The cementitious nature of Monokote limited the number of fibers released. The combination of the very short exposure periods and the limited fiber release resulted in exposures substantially less than those associated with the installation of the fireproofing and other Monokote-related jobs.

Based on the same principles, a similar analysis could be made of exposures associated with the use of vermiculite attic insulation or any other product exposure scenario.

A comprehensive review of the various sources of information used to estimate exposure will provide a range of exposure estimates. This is not a problem related to the imprecision of the data, but rather represents the natural and expected variability in exposures. A critical review of each source of information will have to be made to judge its relevance to the exposures reported by the claimant population. Each potential source of data will be judged on its own merits in order to develop the appropriate exposure entries into the JEM. Criteria such as the specificity of the product and process to claimants' reports, the number and consistency of samples, and the reporting of long-term vs. short term exposure estimates will be evaluated in this determination.

Protocol for exposure assessment

Exposure assessment for the claimant population will be based on the merger of information gathered from two main sources. Claimants' responses to the *W.R. Grace Asbestos Personal Injury Questionnaire* will provide information concerning jobs/tasks, asbestos-containing products used, and associated use time frames for each individual. Information gathered from historical documents, publications, reports, and other sources described in the previous sections will help define the exposures (*i.e.*, airborne asbestos fiber concentrations) associated with those jobs and products. Merging these two sets of information should permit the assessment of cumulative asbestos fiber exposures of each claimant or group of claimants. The first step in the exposure evaluation involves invoking the temporal relationship criteria described by Hill, with some corollaries specific to these circumstances. The practical application of this principal means that any claim of exposure to a W.R. Grace product before it was manufactured is invalid and will be rejected from inclusion in exposure calculations. Similarly, the claim of installation of a W.R. Grace product long after production ended will also be rejected although an arbitrary period of time past cessation of manufacture (to deplete stock held in various warehouses) may be incorporated. Note that this exclusion will not apply to claims related to jobs that may involve the disturbance of installed materials, no matter how long it had been since installation.

Claimant responses to Parts III and IV of the questionnaire will provide individual information on product, dates of exposure, job title, industry, and proximity to the source of exposures for each site in which exposure to W.R. Grace products is alleged. Responses to Part V of the questionnaire will provide parallel information for alleged exposure to asbestos-containing products other than those manufactured by W.R. Grace. A complete work history, which may involve exposure to other carcinogens, will be developed from responses to Part VI of the questionnaire. The accuracy of the assessment of exposure (and thereby the validity of the risk

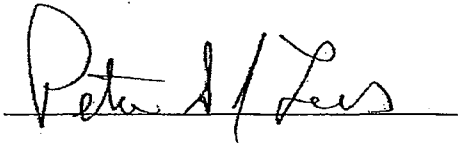
EXPOSURE ASSESSMENT REPORT

OCTOBER 3, 2006

and liability calculation) hinges critically on provision of complete, reliable, and accurate data in claimants' responses to the questionnaire.

At this time, development of the specific evaluation methodology for assessing exposure estimates for the claimant population is continuing. Since complete response data from the questionnaires are not available at this time, there is incomplete knowledge of exposure claims with respect to important variables such as exposure situations and jobs. My future analysis may focus on certain types of claims, job descriptions, or exposures, depending on analysis of questionnaire responses. My analysis is ongoing; I reserve the right to further develop and/or otherwise supplement the exposure assessment methodology, other opinions, and conclusions described in this report in the future, on the basis of additional information from questionnaires and other sources that may become available to me.

Quantitative assessment of the asbestos-related health risk of the claimant population rests on reliable and valid estimation of the asbestos exposure of that population. Such estimates may be possible for this population, however, through the use of widely recognized exposure reconstruction techniques in combination with information garnered from claimants' responses to the *W.R. Grace Asbestos Personal Injury Questionnaire*.

A handwritten signature in black ink, appearing to read "Peter J. Zies", written over a horizontal line.

Signature

October 3, 2006

Date